

## **Guidance on the establishment and use of “Diagnostic Reference Levels” (DRLs) as the term is applied in the Ionising Radiation (Medical Exposure) Regulations 2000**

One of the key issues in the regulations that govern the use of ionising radiation in medicine is the establishment and use of “diagnostic reference levels” (DRLs). The Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R 2000) [1], require employers to establish DRLs and to undertake appropriate reviews if these are consistently exceeded. A multidisciplinary Working Party with representatives from all the professional bodies involved in diagnostic medical exposures was convened by the Department of Health in 2000 to provide broad policy guidance on these IR(ME)R requirements and to formally adopt national DRLs. An employer may decide to adopt national DRLs or to set higher or lower DRLs dependent on the imaging equipment available to them or the patient case-mix of the healthcare establishment. Local DRLs higher than those set nationally would need to be justified. This flexibility enables professionals to provide input at a local level to the DRL setting process. The regular review of these DRLs at national and local level provides a feedback loop that ensures good practice in medical exposures is maintained. More detailed pragmatic advice on how to use DRLs for medical x-ray examinations is available in IPEM Report 88 [2].

At its second meeting in 2004 the DH DRL Working Party agreed that national DRLs for radiographic and fluoroscopic x-ray examinations would be based primarily on the 2000 review of NRPB’s (now the Radiation Protection Division of the Health Protection Agency) national patient dose database [3]. Similarly, national DRLs for computed tomography (CT) examinations would be based on the latest (2003) review of NRPB’s CT patient dose database [4]. Additional values for dental and mammographic x-ray examinations have been derived from published dose data and recommended reference doses from other national surveys [5,6] as indicated in the following Tables. Tables 1-3 list national DRLs for adult patients for radiographic, fluoroscopic and CT examinations while Tables 4-5 list national DRLs for paediatric patients of different ages for radiographic/fluoroscopic and CT examinations. All these national DRLs have been endorsed by the relevant professional organisations that are represented on the DH DRL Working Party.

When considering DRLs for nuclear medicine procedures members of the DH DRL Working Party were content to adopt those set by the Administration of Radioactive Substances Advisory Committee (ARSAC) in its Notes for Guidance on the Clinical Administration of Radiopharmaceuticals and Use of Sealed Radioactive Sources [7]. The latest Guidance is available on the ARSAC website at [www.arsac.org.uk](http://www.arsac.org.uk). Diagnostic reference levels are provided for nearly 100 types of diagnostic nuclear medicine procedure for adult patients in Appendix 1 of the ARSAC Notes for Guidance and they are not reproduced here.

National DRLs will be reviewed and formally adopted by the Department of Health on a regular basis as new nationally representative patient dose data becomes available.

### **References**

1. Department of Health. The Ionising Radiation (Medical Exposure) Regulations 2000. Statutory Instruments 2000 No. 1059 (The Stationery Office, London).
2. Institute of Physics and Engineering in Medicine DRL Working Party. Guidance and Use of Diagnostic Reference Levels for Medical X-Ray Examinations. IPEM Report 88 (IPEM, York) 2004.

3. Hart D, Hillier MC and Wall BF. Doses to Patients from Medical X-ray Examinations in the UK – 2000 Review. NRPB-W14 (NRPB, Chilton) 2002.
4. Shrimpton PC, Hillier MC, Lewis MA and Dunn M. Doses from Computed Tomography (CT) Examinations in the UK – 2003 Review. NRPB-W67 (NRPB, Chilton) 2005.
5. Napier I. Reference doses for dental radiography. British Dental Journal, 186, 392-396, 1999.
6. Young KC, Burch A and Oduko JM. Radiation doses received in the UK Breast Screening Programme in 2001 and 2002. British Journal of Radiology, 78, 207-218, 2005.
7. Administration of Radioactive Substances Advisory Committee (ARSAC). Notes for Guidance on the Clinical Administration of Radiopharmaceuticals and Use of Sealed Radioactive Sources. (HPA, Chilton) March 2006.

Table 1: National DRLs for individual radiographs on adult patients

<b>Radiograph</b>	<b>Entrance surface dose (ESD) per radiograph (mGy)</b>	<b>Dose-area product (DAP) per radiograph (Gy cm<sup>2</sup>)</b>	<b>Reference</b>
Skull AP or PA	3	-	3
Skull LAT	1.5	-	3
Chest PA	0.2	0.12	3
Chest LAT	1.0	-	3
Thoracic spine AP	3.5	-	3
Thoracic spine LAT	10	-	3
Lumbar spine AP	6	1.6	3
Lumbar spine LAT	14	3	3
Lumbar spine LSJ	26	3	3
Abdomen AP	6	3	3
Pelvis AP	4	3	3
<b>Patient entrance dose (PED) per radiograph (mGy)</b>			
Dental bitewing (mandibular Molar)	4	-	5
<b>Mean glandular dose (MGD) per mammogram (mGy)</b>			
Lateral oblique view of 55 mm compressed breast	3.5	-	6

Table 2: National DRLs for complete examinations (excluding CT) on adult patients

<b>Examination</b>	<b>Dose-area product (DAP) per examination (Gy cm<sup>2</sup>)</b>	<b>Fluoroscopy time per examination (min)</b>	<b>Reference</b>
Barium swallow	11	2.3	3
Barium meal	13	2.3	3
Barium follow through	14	2.2	3
Barium enema	31	2.7	3
Small bowel enema	50	10.7	3
IVU	16	-	3
MCU	17	2.7	3
Nephrostography	13	4.6	3
Retrograde pyelography	13	3.0	3
T-tube cholangiography	10	2.0	3
Hysterosalpingography	4	1.0	3
Sialography	1.6	1.6	3
Venography (leg)	5	2.3	3
Coronary angiography	36	5.6	3
Femoral angiography	33	5.0	3

Table 3: National DRLs for CT examinations on adult patients

Examination ( <i>clinical indication</i> )	CTDI <sub>vol</sub> (mGy)		DLP (mGy cm)		Reference
	SSCT	MSCT	SSCT	MSCT	
Routine head ( <i>acute stroke</i> ):					
Posterior fossa	65	100	-	-	4
Cerebrum	55	65	-	-	4
Whole exam	-	-	760	930	4
Chest ( <i>lung cancer or metastases</i> ):					
Lung	10	13	-	-	4
Liver	11	14	-	-	4
Whole exam	-	-	430	580	4
Chest: Hi res. ( <i>diffuse lung disease</i> )					
Whole exam	3	7	80	170	4
Abdomen ( <i>liver metastases</i> ):					
Whole exam	13	14	460	470	4
Abdomen & pelvis ( <i>abscess</i> ):					
Whole exam	13	14	510	560	4
Chest, abdomen & pelvis ( <i>lymphoma staging or follow up</i> ):					
Lung	10	12	-	-	4
Abdomen/pelvis	12	14	-	-	4
Whole exam	-	-	760	940	4

Table 4: National DRLs for complete examinations (not CT) on paediatric patients

<b>Examination</b>	<b>Standard age (y)</b>	<b>Dose-area product (DAP) per examination (Gy cm<sup>2</sup>)</b>	<b>Reference</b>
MCU	0	0.4	3
	1	1.0	3
	5	1.0	3
	10	2.1	3
	15	4.7	3
Barium meal	0	0.7	3
	1	2.0	3
	5	2.0	3
	10	4.5	3
	15	7.2	3
Barium swallow	0	0.8	3
	1	1.5	3
	5	1.5	3
	10	2.7	3
	15	4.6	3

Table 5: National DRLs for CT examinations on paediatric patients

<b>Examination (clinical indication)</b>	<b>Age (y)</b>	<b>CTDI<sub>vol</sub> (mGy)</b>	<b>DLP (mGy cm)</b>	<b>Reference</b>
<b>Head (trauma):</b>				
Posterior fossa	0-1	35	-	4
Cerebrum	0-1	30	-	4
Whole exam	0-1	-	270	4
Posterior fossa	5	50	-	4
Cerebrum	5	45	-	4
Whole exam	5	-	470	4
Posterior fossa	10	65	-	4
Cerebrum	10	50	-	4
Whole exam	10	-	620	4
<b>Chest (detection of malignancy):</b>				
Whole exam	0-1	12	200	4
Whole exam	5	13	230	4
Whole exam	10	20	370	4